CLIMATE CHANGE ADAPTATION ADVISORY COMMITTEE

POTENTIAL STRATEGIES

October 20, 2009

CLIMATE CHANGE
ADAPTATION ADVISORY COMMITTEE
POSSIBLE STRATEGIES
Subcommittee Briefings

COASTAL ZONE and OCEANS

KEY FINDINGS

- Build on existing knowledge base to fill critical gaps and improve risk identification
- Develop criteria, set priorities, and establish or modify policies to determine where protection should be advanced and where managed retreat is more prudent
- Intensify efforts to reduce stress on natural systems and increase resiliency
- Integrate flexible and adaptive practices that address cumulative impacts into resource management systems

Strategy #1: RESIDENTIAL and COMMERCIAL DEVELOPMENT, PORTS and INFRASTRUCTURE

- **Site development outside of projected high-risk and future resource areas**

- **Design according to projected risk over life of project**
  - Delineate high-hazard zones using projected sea level rates
  - New Executive Order to direct State development out of high-risk areas
  - Modifications or policy guidance for regulatory programs (e.g., MEPA alternative analyses; Chapter 91 performance standard; Wetlands Protection Act resource areas)
  - Financial and other mechanisms such as availability of private insurance: other subcommittees (local economy?)

Strategy #1: RESIDENTIAL and COMMERCIAL DEVELOPMENT, PORTS and INFRASTRUCTURE

- **Institute policies and regulations to improve assessment of erosion and flooding and evaluation of design and placement of engineered approaches:**
  - Advance soft engineering approaches that supply sediment to resource areas
  - Develop sand mining policy to guide use of Commonwealth submerged estuarine / marine resources
  - Prioritize placement of sediment on public beaches
  - Strengthen public access easements on private beaches
  - Evaluate alternatives to repair of failing public structures
  - New plans for structures must accommodate local conditions and sea level

Strategy #2: COASTAL ENGINEERING for SHORELINE STABILIZATION and FLOOD PROTECTION

- **Institute policies and regulations to improve assessment of erosion and flooding and evaluation of design and placement of engineered approaches**
  - Advance soft engineering approaches that supply sediment to resource areas
  - Develop sand mining policy to guide use of Commonwealth submerged estuarine / marine resources
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Strategy #3: COASTAL ESTUARINE, and, MARINE HABITATS, RESOURCES and ECOSYSTEM SERVICES

- **Improve resiliency** of natural habitats, communities, and populations through land conservation, habitat restoration, and "green" infrastructure

- **Reduce anthropogenic stressors** through directed improvements in estuarine and marine water quality

- **Fisheries management** systems need ecosystem-based approaches and flexibility in tools (quotas, catch-shares, etc.) to ensure that targets are realistic, achievable, and avoid unnecessary burdens on recreational and commercial fisheries

Strategy #3: COASTAL ESTUARINE, and, MARINE HABITATS, RESOURCES and ECOSYSTEM SERVICES

- **Improve shellfish management and aquaculture through better predictions of harmful algal blooms, marine pathogens, and rainfall**

- **Increase estuarine and marine monitoring, observations, and assessments to ensure that**
  - Adequate capabilities exist in the Commonwealth to provide sustained, high-resolution time series at key locations for critical parameters
  - Biological surveys and assessments support increased understanding of changing ecosystem processes
  - Models can be developed to run scenarios of future conditions and test hypotheses

Thank you.

Questions?

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POSSIBLE STRATEGIES
Subcommittee Briefings

HUMAN HEALTH and WELFARE

KEY SECTORS REVIEWED

- General Strategies
- Public Health Infrastructure
- Vector-Borne Diseases
- Ambient Air Quality
- Indoor Air Quality
- Water Quality
- Agriculture and Food Systems
- General Welfare: Cultural Resources
  (Note: now in local economy chapter)

GENERAL STRATEGIES

- Implement **mitigation** strategies that reduce emissions of particulates and ozone precursors to **improve air quality**
- Screen climate **mitigation** strategies through the health and environmental lens, to **minimize unintended consequences** and maximize co-benefits
- Support **healthy city** and regional planning in areas of energy, transport and green infrastructure to promote healthy living
- Increase **access to health insurance** and medical care, medical support equipment and medications
- Increase **support for hospitals and health centers** expected to bear disproportionate share of service demands
- Conduct **outreach and education** to connect individuals and families to appropriate services
- **Winter Weather Anomalies**, an underappreciated issue for health and safety

PUBLIC HEALTH INFRASTRUCTURE

- **Planning, Policy, and Governance**
  - **Emergency preparedness** and response is a key part of public health programs: ensure robust capacity at appropriate scale
  - Conduct public health climate change **planning** to identify most vulnerable facilities and responsive capacities
  - Promote an **education campaign** to address vulnerabilities
  - Conduct **capacity assessments** of care providers for increased patient volumes and changing health demands
  - Enhance **regionalization** efforts among local Boards of Health

PUBLIC HEALTH INFRASTRUCTURE

- **Facilities**
  - **Modify health care facilities** as opportunities arise to improve flood control protection.
  - Use **distributed sources of energy** generation to increase preparedness and resiliency of the network of health care providers for surge capacity and extreme events
  - Develop plans to **relocate health care facilities** away from the coastline and stabilize facilities in flood prone areas
  - Plan for physical facilities needed for **heat wave preparedness**: health services and cooling centers

- **Services**
  - Promote workforce development to **train public health staff** to respond to health threats posed by climate change
  - Implement DPH **Asthma Action Plan** to improve our ability to adequately treat chronic asthma with effective care plans

VECTOR-BORNE DISEASES

- **Surveillance, Monitoring and Reporting**
  - Streamlining and automating **reporting mechanisms**, including web-based entry and access
  - Maintain **mosquito surveillance** and develop a systematic tick surveillance program statewide to monitor vector densities and infection rates
  - Continue requiring **reporting** of human cases and positive laboratory results of vector-borne diseases
  - Monitor current **non-endemic diseases** for trends
  - Improve **vector and human surveillance** in order to identify high risk groups and places to better target outreach
  - Continue **testing** to identify other, currently non-endemic, viral agents

VECTOR-BORNE DISEASES (Cont'd)

- **Communication, Education and Pest Management**
  - Use of community based and trade organizations to do outreach and education on **risks and prevention**, and facilitate connections to appropriate care
  - Educate the public, particularly high risk groups, about **personal prevention practices**
  - Develop strategies for large scale use of **integrated pest management** control to reduce pesticide use

- **Treatment Capacity and Quality**
  - Ensure sufficient supplies for **disease prevention**
  - Improve **surge capacity**
  - Increase access to **health insurance** and medical care including medical support equipment and medications

AMBIENT AIR QUALITY

- **Standards and Controls**
  - Require controls to attain **air quality standards** for ozone precursors and other asthmogens
  - Develop and enforce legal standards that reduce allowable **limits on asthmogen** releases
- **Surveillance and Tracking**
  - Build on existing public health practice of surveillance and health outcome tracking in order to identify and monitor health impacts
- **Communication and Assistance**
  - Provide technical advice and communicate the health-related aspects of climate change
  - Provide technical and financial support to companies to reduce their ambient air emissions: **ozone and particulates**

AMBIENT AIR QUALITY (Cont'd)

- **Research and Forecasting**
  - Enhance the **science knowledge base** to better understand the relationship between climate change and health outcomes
  - Expand capacity for **modeling and forecasting** health effects using standardized health impact assessments
  - Invest in scientific and technological research to identify novel means to **reduce air pollution**
  - Develop and use climate forecasting services and remote sensing to **predict heat waves**, resulting air quality conditions and health effects

- **Landscaping and Planning**
  - Plant **hypo-allergenic trees** in communities with high rates of asthma and lung dysfunction
  - Promote creating green spaces in urban cities to reduce heat island effect

INDOOR AIR QUALITY

- **Standards**
  - Consider modifying **ventilation standards** (Building Code)
  - Strengthen and enforce laws to protect tenants and require property owners take action to **remediate mold**, including applying a strict liability standard for indoor asthmogens.

- **Support and Assistance**
  - Provide technical and financial support to property owners to **remediate mold** problems
  - Reduce or **remove subsidies** for activities and projects that result in reduced ambient air quality

WATER QUALITY

- **Monitoring and Evaluation**
  - Continue to monitor water quality reports, toxicology reports, epidemiologic reports, and the impacts of storms and hurricanes on **water-borne diseases**
  - Work with communities and provide local authorities information about weather impacts on both **water supply and increased coastal flooding**
  - Gather information on exposures and diseases related to extreme weather events and flooding, and the impact of climate change on **morbidity and mortality**

- **Standards**
  - Improve **water management**, including improving and enforcing water quality protections
  - Re-evaluate the standards for the design and maintenance of **septic systems**, as well as the development of municipal sewer system and solid waste treatment facilities
  - Implement better control of agricultural, urban and stormwater **runoff** to prevent contamination and nutrient enrichment that offers the ideal growth medium for harmful algal blooms

WATER QUALITY (Cont'd)

- **Responsive Capacity**
  - Assess and plan for impacts on regulatory and monitoring activities, as well as incident response resources
  - Encourage or require **public drinking water systems** to evaluate climate risks to health and consider a variety of risk reduction strategies
  - Use **climate forecasting** and remote sensing: climate services being developed by NOAA

- **Promoting Water Conservation**
  - Provide technical and financial support to individual property owners to promote the adoption of water conservation practices
  - Implement effective water conservation methods
  - Provide technical assistance to businesses to help reduce water use and improve water conservation
  - Implement graduated water rates tied to water usage

AGRICULTURE and FOOD SYSTEMS

- **Monitoring and Tracking**
  - Continue to monitor **food supplies** for potential disease outbreaks
  - Track **food-borne illnesses** to determine if new patterns or agents are emerging.
  - Provide funding and personnel devoted to monitoring for **new insects, weeds, and pathogens** that are likely to expand their range into Massachusetts

- **Financial Assistance and other Incentives**
  - Provide financial / technical support for infrastructure adaptations such as irrigation, drainage, livestock facilities, transitioning to new crops at appropriate scales
  - Modify **subsidy eligibility** to ensure access to healthy foods
  - Provide technical and financial support to assist **small farms** to bring produce to new markets. In urban areas this may include support for participation in community supported agriculture by low income families
  - Provide **disaster assistance or insurance** for small farms for crop losses
  - Provide technical assistance and outreach in partnership with existing federal programs (Example: USDA, NRCS)

AGRICULTURE and FOOD SYSTEMS (Cont'd)

- **Research**
  - Assess the cost of food in relation to income and nutritional value
  - Research crop adaptation and diversity

- **Pesticide Management**
  - Revisit integrated pest management **thresholds and strategies**
  - Increase **educational efforts** for pesticide risk management, crop adaptation and management, and conservation practices.
  - Increase efforts to **monitor** the use and occurrence of pesticides in the environment
  - Improve state level **health and safety laws** relating to pesticide/herbicide exposure prevention
  - Encourage adoption of best practices to **control runoff** of pesticides as well as nutrients, fertilizers, and soil that contribute to poor water quality
  - Increase/improve support for and enforcement of federal and state **OSHA laws** relating to pesticide exposure prevention

AGRICULTURE and FOOD SYSTEMS (Cont'd)

- **Standards**
  - Modify development/ zoning priorities to increase access to places to purchase fresh food
  - Improve and enforce water quality protections for water bodies that are used for subsistence fishing

- **Partnerships and Outreach**
  - Develop partnerships with related federal agencies and state programs for planning and program operations.
  - Conduct outreach and education targeting vulnerable population groups and their employers about health and safety precautions

Thank you.

Questions?

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KEY INFRASTRUCTURE

KEY SECTORS

- Energy (electric, gas, petroleum)
- Transportation (land, sea, air)
- Water (supply, wastewater, stormwater)
- Safety and Flood Control
- Solid and Hazardous Waste
- Built Infrastructure and Buildings

EXAMPLES OF COMMON STRATEGIES

- **Revise Regulatory and Design Requirements**
  - regulatory and review processes at the state and local level,
  - design manuals, standard specifications and guidance,
  - building codes.
- **Update asset inventories with accurate survey and updated hazard mapping**
- **Increased financial support for adaptation programs (key at local level)**
- **Enhanced regional coordination and networking**

EXAMPLES OF COMMON "NO-REGRETS" STRATEGIES

- Better preparation for extreme weather events just makes sense
- Conservation, efficiency and reuse strategies: adaptation and mitigation benefits
- Integrate near term adaptation strategies into planned asset upgrades as well as operations and maintenance procedures
- Maximize use of natural systems, e.g. watersheds, wetlands, coastal features

EDUCATION, OUTREACH AND TECHNICAL ASSISTANCE

(EOT&A)

- Develop "sector specific" EOT&A
- Special emphasis on municipal EOT&A
- Target decision makers with focused EOT&A
- General public EOT&A strategy
- Designate a lead agency to manage and coordinate

THINKING OUTSIDE THE BOX

- **"Protecting" versus "Retreating"**
  - many capital intensive assets already in high risk areas,
  - decision makers need to realize magnitude of these risks,
  - what are key criteria for decision makers on "protect" vs. "retreat"

- **Re-establish and maximize use of natural systems**
  - land use restrictions
  - mandatory stormwater enhancements (e.g. Low Impact Development, keeping water local)
  - "re-plumb" watersheds

- **Financial incentives (and maybe legal requirements)**
  - begin to decentralize major "high risk" centralized assets
  - "re-plumb" watersheds
  - Avoid development in high risk areas

- **Develop risk based, probabilistic methods to evaluate infrastructure service life risks**

- **"Clean State Model" to manage and coordinate progress across all sectors**

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ENERGY

(electric, gas, petroleum)

- Educate asset owners and regulators on risks and strategies
- Prioritize and begin near term adaptation strategies for assets in high risk areas
- Develop enhanced design and performance standards for new and major modifications
- Utilize new technologies to provide resiliency and reliability in existing systems, e.g. “Smart Grid”
- Encourage and create incentives for supply diversity and use of renewable resources
- Encourage energy efficiency

TRANSPORTATION

(land, sea air)

- Prepare guidance on cost effective near term adaptation efforts
- Begin implementation of near term enhancements
- Adjust operations and management programs to integrate adaptation strategies
- Begin work on planning for longer term strategies
- Regional “cross fertilization” on adaptation strategies

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WATER

(Supply, Wastewater, Stormwater)

- ***Enhance Natural Systems***: One overarching adaptation measure common to preserving water supply operations, wastewater treatment, stormwater systems, and river and coastal structures (dams, levies, sea walls, etc.) is to take measures to reduce stress on these water-related infrastructures.

- ***Increase Conservation and Reuse Effort***: Enhance current efforts to conserve water, reduce wastewater discharge, and decrease stormwater runoff.

- ***Offset Impacts to Water Supplies***: Adaptation strategies specific to offsetting impacts to water supply include revising the Massachusetts State Plumbing Code to encourage water conservation, and assessing the potential to increase water supplies through non-traditional processes, including reuse of non-potable water/grey-water technologies.

- ***Make Near-Term Changes to Publicly Owned Treatment Works***: Flood-proof vulnerable wastewater facilities by raising elevation of structures above predicted flood stages, installing watertight doors and windows, replacing wet/dry well pumps with submersible pumps, increasing emergency back-up provisions to keep all key equipment operational, and relocating vulnerable equipment.

WATER

(Supply, Wastewater, Stormwater)

- ***Address Stormwater Flows*:**
  - Infiltrate stormwater into the ground close to its site of origin
  - Finalize the draft stormwater regulations and apply them statewide to upland areas as well
  - Aggressively expand implementation of Low Impact Development as a stormwater mitigation mechanism.
  - Periodically evaluate the long-term control plans for Combines Sewer Overflow's developed by the 24 Massachusetts communities to determine if additional efforts are needed to protect the environment and public health from more frequent Combines Sewer Overflow activations
  - Expand public outreach and education efforts concerning the negative impacts of stormwater on flooding, the quality of our rivers and streams, and the quantity of water in our aquifers.

- ***Enhance the SRF Program**:* Review and modify the SRF program to create incentives for communities to address climate change impacts and avoid investments in highly vulnerable areas

** The State Revolving Fund (SRF) program provides $100 million of low-interest loans for Clean Water and Drinking Water projects.*

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DAM SAFETY and FLOOD CONTROL

- Update extreme weather events predictions and models used in design and safety analyses,
- Prepare and/or revise emergency action plans,
- Work with dam owners and insurance providers on enhanced programs to cover updated risk assessments,
- Institute a dam removal program,
- Engage in regional and national networking opportunities

SOLID and HAZARDOUS WASTE

- **Identify facilities in high risk areas**
- **Revise regulatory requirements to address adaptation needs**
  - sitting requirements for new or expanded facilities
  - enhance emergency planning and emergency response requirements in high risk areas
  - new design performance standards, e.g. at landfills
- **Implement Disaster Debris Management Plan**
- **Assistance program for local level debris plans**

BUILDINGS and BUILT INFRASTRUCTURE

- Develop near term guidance for existing assets in high risk areas
- Require adaptation considerations for all new public structures
- Reviews and permits for private developments should address adaptation needs
- Continually review and modify universal design requirements based on climate change impacts and subsequent experiences

EMERGENCY MANAGEMENT

- **Integrate all updated key infrastructure asset inventories and "risk" mapping,**
- **Update state/public assets inventory, and prioritize "risk",**
- **Incorporate climate change impacts into State Comprehensive Emergency Management Plan,**
- **Assess capacity at state and local level to respond and recover from expected climate change impacts,**
- **Expand capacity to respond and recover,**
- **Expand scope of State Hazard Mitigation Plan,**
- **Education and outreach on cost benefits of "pay me now" vs. "pay me later"**

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Thank you.

Questions?

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CLIMATE CHANGE ADAPTATION STRATEGIES

Subcommittee Briefings

LOCAL ECONOMY and GOVERNMENT

KEY SECTORS

- Agriculture, including Forestry and Fishing/Aquaculture
- Manufacturing/Industry
- Service Industries: Real Estate Management, Health Care, Higher Education, Tourism and Recreation
- Cultural Resources
- Government

AGRICULTURE, FORESTRY and FISHING/AQUACULTURE

- **Impacts on Crops and Soils**
  - Soils research, crop alterations and fortification
  - Development of agricultural hybrids
  - Expanded crop planting/seasons
- **Impacts on Agricultural Operations**
  - Escalation of pest monitoring and management
  - Improved harvest storage
  - Buy local
  - Changing nature of seasonal labor pools
  - Alternative Energy Development
  - Improved Water Use Strategies
    - Reduce the competition over water
    - Increased use of storage

MANUFACTURING / INDUSTRY

Computers, Electronic Equipment, Fabricated Metal, Machinery

- Consider long-term siting alternatives that avoid or address impacts of climate change
- Improve designs for buildings to better withstand more frequent periods of flooding
- Increase supply inventories and identify alternate suppliers
- Alter operation schedules to cooler times of day
- Seek alternate transportation routes, energy supplies and communication systems for suppliers, customers and workers

MANUFACTURING / INDUSTRY

Computers, Electronic Equipment, Fabricated Metal, Machinery

- **Protect water as an asset**
  - Use market-based solutions to preserve water resources and **conserve** water use
  - Improve designs for on-site **stormwater** management, especially at facilities in low lying areas
  - Increase **water storage**, taking advantage of high rain periods to offset drought periods
  - Expand opportunities for **water recycling**, including grey water to address water supply disruptions from drought
  - Reduce water use in energy production. Explore opportunities to **co-produce** energy and water
    - Locating power plants adjacent to wastewater treatment facilities, for example, could partially displace freshwater needs

SERVICE INDUSTRIES

Insurance, Financial Real Estate Management, Health Care, Higher Education, Tourism and Recreation

- Revise calculation of potential risks to incorporate SLR and floodplain alterations
- Revise mortgage banking formulas to better reflect the true cost of risk over time
- Work with FEMA to prioritize areas of redevelopment and reduced viability thus
- Reduce the exposure of government as the insurer of last resort
- Improve woodland and plant control around buildings
- Improve water conservation to minimize effects of a water shortage

SERVICE INDUSTRIES

Insurance, Financial Real Estate Management, Health Care, Higher Education, Tourism and Recreation

- Improve science and research on prevention and cures of vector borne diseases
- Increase public awareness on the use of protective clothing
- Address potential changes in seasonal labor pools due to longer warm weather climate
- Alter staff deployment/staff funding to recreation sites of consistent high use
- Expand public/private recreational programs to share cost burdens

SERVICE INDUSTRIES

Insurance, Financial Real Estate Management, Health Care, Higher Education, Tourism and Recreation (contd)

- **Educate public and private employers about OSHA requirements regarding employee protections in times of high heat**
- **Shift work schedules to cooler times of day whenever possible**
- **Alter snowmaking operations at enterprises dependent on snow cover**
- **Increase attentiveness to emergency preparedness**
  - For cold weather accidents
  - Assess capacity to address potential coastal and inland flooding
  - Establish alternatives to avert temporarily overwhelming of local health care facilities
  - Review emergency management plans of historic/cultural assets

CULTURAL RESOURCES

- Include vulnerabilities in decisions
- Consider structural reinforcement
- Prioritize sites for study
- Maintain and increase climate control capabilities, including opportunties for natural site climate control capabilities
- Prepare historic landscapes for drought
- Maintain and develop emergency management plans
- Increase monitoring and records of the type and extent of existing vegetation

GOVERNMENT

- **General Preparedness**
  - Local government can best understand and prepare for its own challenges by developing its own climate change protection strategy
  - Continued data collection and research: LIDAR
  - Develop an education curriculum for those who will design and build our future

GOVERNMENT

- **Resiliency**
  - **Collaborate with trade associations and the insurance industry, promoting research /development of new technologies and engineering strategies**
  - **Strengthen design standards**
    - for grant awards and procurements
    - to preserve and restore natural hydrology, restore and/or create flood storage
  - **Explore revision of stormwater regulations**
  - **Improve general maintenance on roadways**
  - **Require that community master (comprehensive) plans include a climate change impact assessment and mitigation strategy**
  - **Target infrastructure funding to redirect development toward less vulnerable areas.**
  - **Ensure that "at risk" buildings and infrastructure are structurally prepared for weather extremes**
  - **Include climate change impacts into MEPA and permit processes**

GOVERNMENT

- **Emergency Preparedness**
  - **Increase capacity and greater cooperation with the business community, forestry management, and the tourism industry**
  - **Increase regional cooperation**
  - **Continue assessment of equipment, supplies, and evacuation facilities**
  - **Consider vulnerable populations during emergency planning efforts, including relocation options**
  - **Engage in hazard mitigation planning**
  - **Practice the execution of communities' emergency action plans & involving local NGOs**
  - **Develop plans to meet increased demand in the aftermath of extreme weather events**
  - **Establish regional alliances or volunteer corps**

Thank you.

Questions?

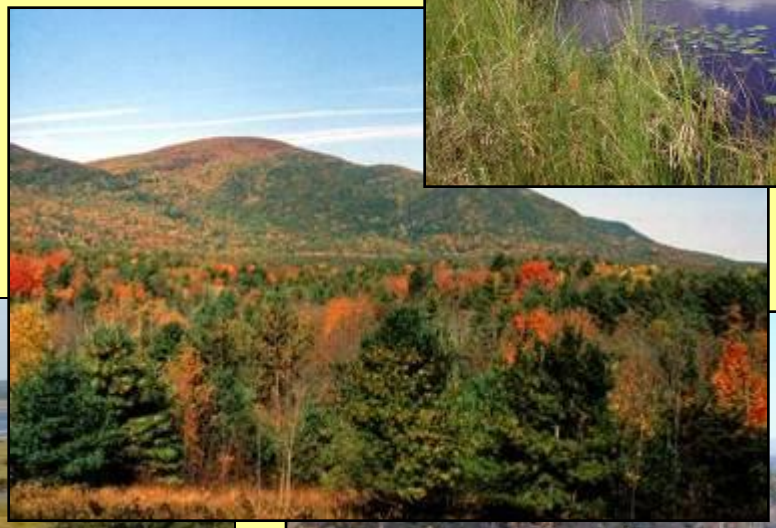
CLIMATE CHANGE ADAPTATION STRATEGIES

Subcommittee Briefings

NATURAL RESOURCES and HABITAT

NATURAL RESOURCE SECTORS

- Forest Ecosystems
- Coastal Ecosystems
- Aquatic Ecosystems
- Wetland Ecosystems
- Intact Landscapes



ECOSYSTEM FUNCTIONS

- Wildlife Habitat
- Biodiversity
- Water Quality/Purification
- Water Storage/Supply/Aquifer Recharge
- Flood Attenuation
- Carbon Sequestration

FUNCTIONS → IMPACTS → STRATEGIES

- **Assessed impacts and vulnerabilities**
  - Many universal across ecosystems, some unique
  - Synergy with other stressors

- **Adaptation strategies to**
  - Help ecosystems resist climate effects
  - Make vulnerable ecosystems more resilient
  - Assist ecosystems likely to be lost/change state

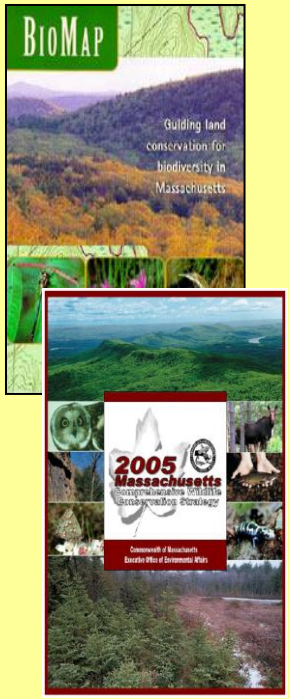
- **Win–Win adaptation strategies**
  - Ecosystem function = Ecosystem services
    - Benefit natural resources & economic, infrastructure, human health and welfare, coastal, and other sectors
    - Economically feasible

STRATEGY TYPES

- **Land & Water Protection**
- **Policy & Flexible Regulation**
  - Funding
  - Planning and prioritization
- **Restoration & Management**
- **Monitoring, Research, & Adaptive Management**

Strategy #1: LAND & WATER PROTECTION
Overarching Principles for all ecosystems

- **Enhance resilience & ecosystem function**
  - Sufficient size to maintain resilience (dynamics)
  - High ecological integrity (e.g. unfragmented)
  - Representation across gradients ("stages")
  - Replication (reduce risk)
  - Connectivity (prevent isolation)
  - Buffers (account for migration)
- **Focused and collaborative protection**
  - State Wildlife Action Plan & BioMap
- **Public funding crucial**



Strategy #1: LAND PROTECTION

- **Targeted acquisition (or easements), examples**
  - Future coastal wetlands
    - Coastal infrastructure protection
  - Headwater streams and buffers
    - Flood attenuation
  - Intact riverine and wetland complexes
    - Water quality and storage
  - Critical coldwater fish habitat
    - Forest reserves/cores
    - Carbon sequestration
  - Working woodlands
    - Forest products
    - Tourism
    - Water quality, flood attenuation

Strategy #2: POLICY, FLEXIBLE REGULATION, PLANNING and FUNDING

- **General Funding, Planning, Coordination**
  - Increased coordination among state agencies, across states, and w/NGOs and academic entities.
  - Climate-adapted State Wildlife Action Plan (SWAP)
    - catalyst for federal adaptation funds, galvanize conservation
  - Climate responsive & integrated land use planning & zoning
  - Smart growth tools and strategies; Low Impact Development

Strategy #2: POLICY, FLEXIBLE REGULATION, PLANNING and FUNDING

- **Wetland & Aquatic Ecosystems**
  - Wetlands Protection Act (WPA):
    - Revise to respond flexibly to a changing climate, Incorporate:
      - flexible wetland delineation criteria that account for drought conditions
      - new regulatory drought definition, ↓ ID of perennial streams as intermittent
      - **greater protection of buffer zones, isolated wetlands, vernal pools (buffers and clusters), and intermittent streams**
    - provide expedited permitting for dam removal projects
  - The Rivers Protection Act (RFA) should be revised to
    - protect meander belt-width river corridors, remove references to "bankful"
    - Promote restoration and discourage development in floodplains
  - Encourage flood control compatible w/ other values, while discouraging traditional engineering techniques that exacerbate flooding/erosion

Strategy #2: POLICY, FLEXIBLE REGULATION, PLANNING and FUNDING

- **Aquatic Ecosystems**
  - Facilitate permit streamlining for restoration projects
  - Develop stream flow criteria and regs to re-establish flows
- **Coastal Ecosystems**
  - Better Engineering-Ecological solutions to SLR
  - Minimize development to aid inland migration
  - Integrated Community Planning
- **Forest Ecosystems**
  - Establish landowner incentives and consider
    - No Net Loss and No Net Fragmentation policies
    - Enhance Chapter 61 enrollment

Strategy #3: MANAGEMENT and RESTORATION

- **General**
  - Reduce current stressors
    - Restore fragmenting features
    - Prevent and control invasive plants, insects, and diseases
  - Support biodiversity richness
  - Maintain ecosystem function and structure

- **Coastal Wetlands**
  - Remove impediments to inland migration
  - Replenish sediments

- **Forest Ecosystems**
  - Maintain vigor & increase factors that promote resilience (diversity of species, forest structure, age, genetic variability)
    - C sequestration
    - Forest products
  - Apply prescribe fire management
    - Reduced threat of wildfire
  - Protect regeneration

Strategy #3: MANAGEMENT and RESTORATION

- **Aquatic Ecosystems:** watershed-scale and reach-level
  - Reconnect high quality habitat
    - Within stream
    - Stream-floodplain
    - (flood attenuation, infrastructure integrity)
  - Promote restoration and creation of floodplains

- **Wetland Ecosystems**
  - Develop flexible and climate-responsive management strategies to support ecological adaptation and resilience
    - Promote riparian zone and floodplain management, restoration and preservation of river processes
    - Reduce nutrient loading of waterbodies
    - Encourage application of bioengineering techniques for erosion control and stream stability

Strategy #4: MONITORING, RESEARCH and ADAPTIVE MANAGEMENT

- **General**
  - Develop better understanding of CC impacts on our region ecosystems, and species
  - Integrate with Long Term Ecological Research/Monitoring projects
  - Support existing monitoring networks, monitor pilot adaptation strategies

- **Coastal Ecosystems**
  - Track movement of tidal resources responding to SLR (gauges, LiDAR, etc.) & integrate with management

- **Aquatic Ecosystems**
  - Standardize monitoring protocols
  - Conduct geomorphic assessments to identify vulnerable river reaches and disconnections from floodplain
  - Update FEMA floodplain maps
  - Improve understanding of river processes to promote sustainable river management

Strategy #4: MONITORING, RESEARCH and ADAPTIVE MANAGEMENT

- **Wetland Ecosystems**
  - Support research on adaptive strategies and pilot projects
  - Support research on interactions between stressors
  - Prepare and distribute a Wetlands and Waterways CC Adaptation best management practices handbook
  - Consolidate MassGIS and NRCS soils mapping and use as tool for management of soil carbon stores
  - Update rainfall data

Climate Change Adaptation Strategies

- **Maintain ecosystem resilience, function, dynamics, services through**:
  - Land & Water Protection
  - Policy & Flexible Regulation
    - Funding
    - Planning and prioritization
  - Restoration & Management
  - Monitoring, Research, & Adaptive Management

CLIMATE CHANGE ADAPTATION STRATEGIES

Subcommittee Briefings

LAND USE

NEW DEVELOPMENT

- Size infrastructure to handle predicted storm events
- Ensure that state investments in infrastructure and development projects reflect climate change concerns, especially future risk
- Use state statutes/regulations to strictly limit construction of new "at risk" buildings and infrastructure
- Site/design development to preserve/restore natural hydrology & restore/create flood storage

EXISTING DEVELOPMENT

- **Ensure that as sea level rises "at risk" buildings and infrastructure are structurally prepared for storm events**

- **Produce a plan that classifies coastal areas by "tier" based on degree of risk, extent of existing development and corresponding investment, sensitivity of natural resources, and other factors**

- **Develop and implement a protocol for each tier that applies appropriate state and local planning, regulatory, infrastructure, investment, and other tools**

PLANNING, REGULATIONS, and ASSISTANCE

- Assign an agency responsibility to gather and provide data and serve as policy advisor on climate change and adaptation strategies in order to coordinate plans, regulations, and investments
- Ensure that state, local, and other land conservation and development plans reflect future climate change risk projections
- Incorporate evaluation of climate change impacts in MEPA and other permitting processes
- Invest land conservation funds to minimize climate change impacts and support adaptation
- Utilize local regulations to minimize the impact of climate change
- Utilize local land use regulations and state building code to limit the heat island effect

Thank you.

Questions?